



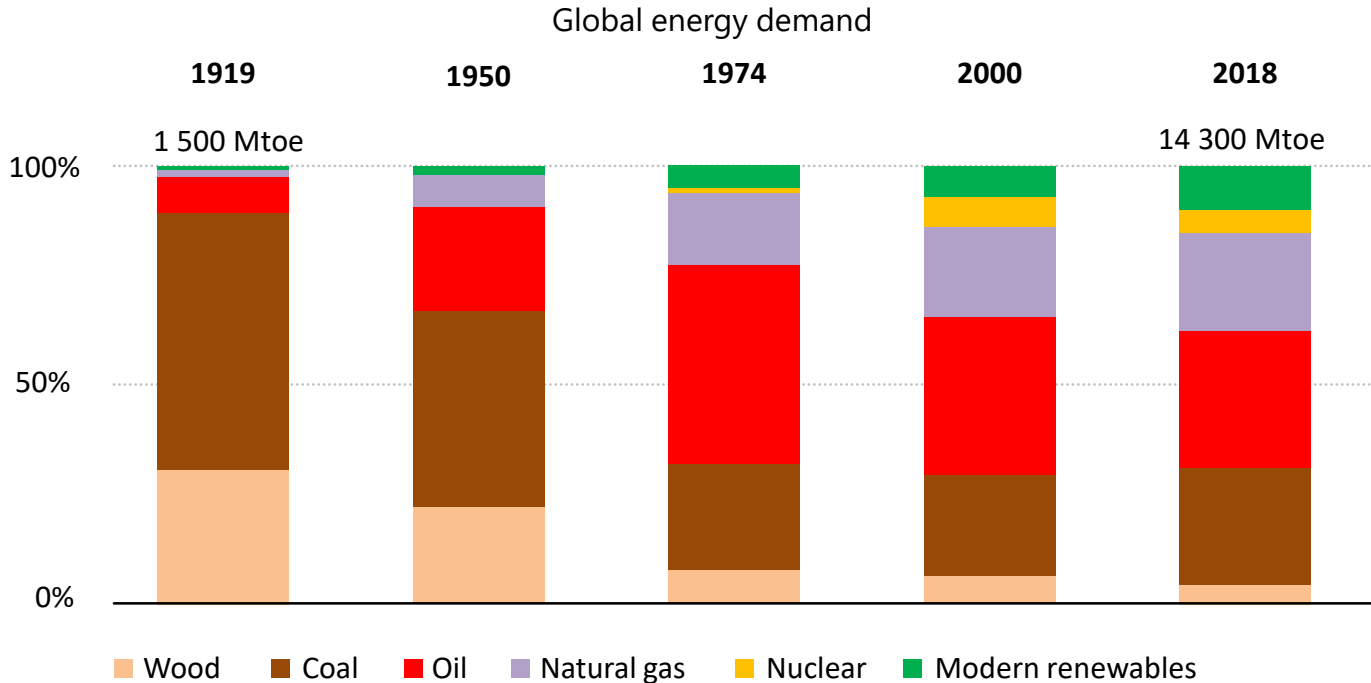
IEA Perspective on Clean Energy Transitions

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Perspectives from energy history

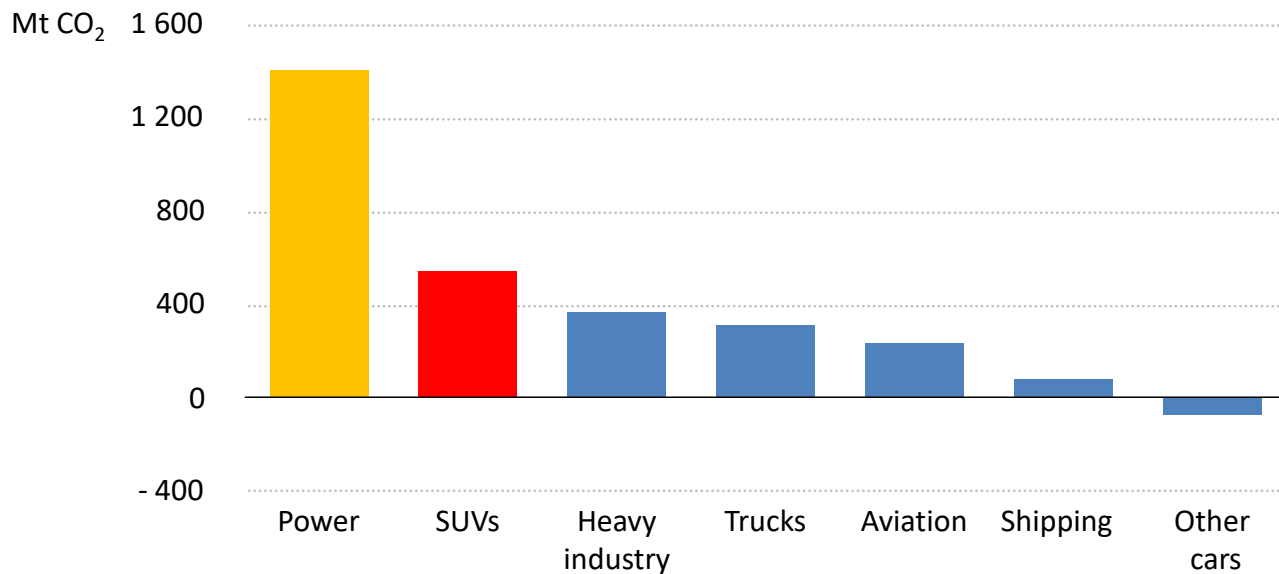


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The last century has witnessed multiple transitions to and from different fuels and technologies
The challenge today is one of scale: global energy use is ten times higher than in 1919.... and growing

Power and SUVs have been the main forces driving emissions higher

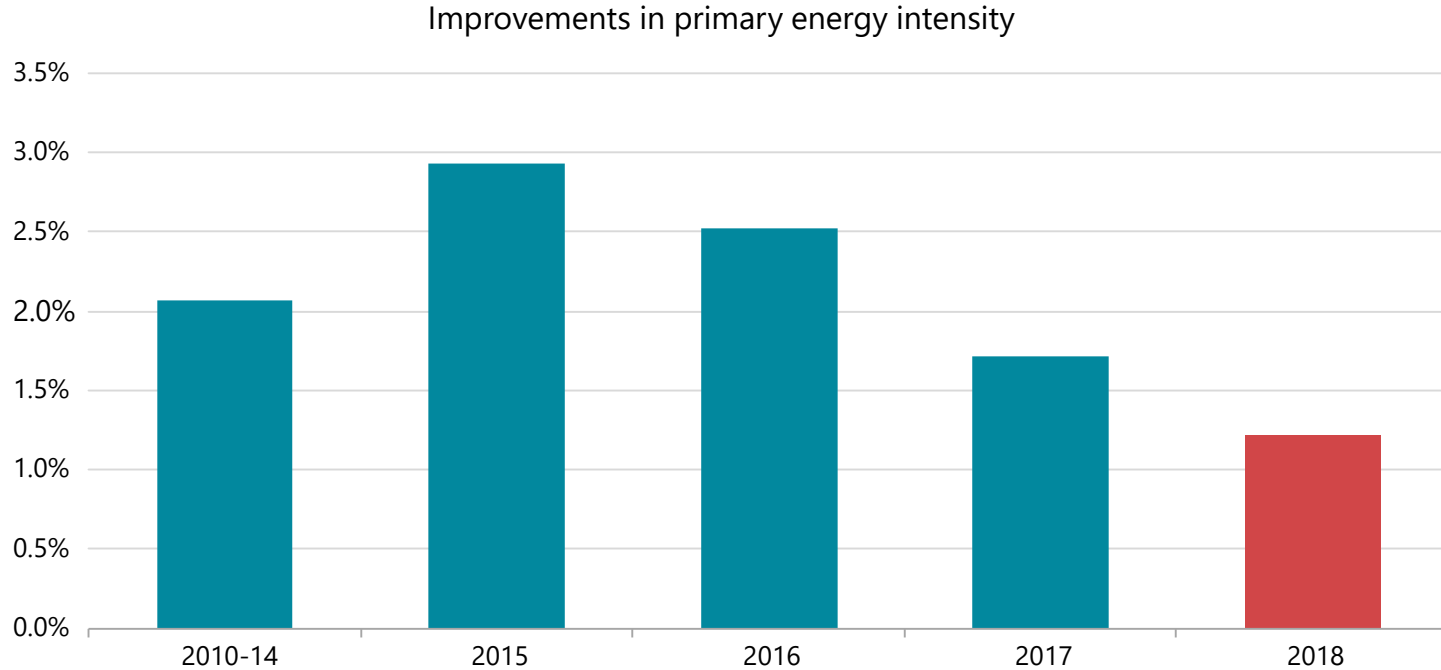
Change in CO₂ emissions by energy sector, 2010-2018



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The global fleet of SUVs increased from 35 million in 2010 to over 200 million in 2018, becoming a major force in rising oil demand and the second-largest reason for CO₂ emissions growth since 2010

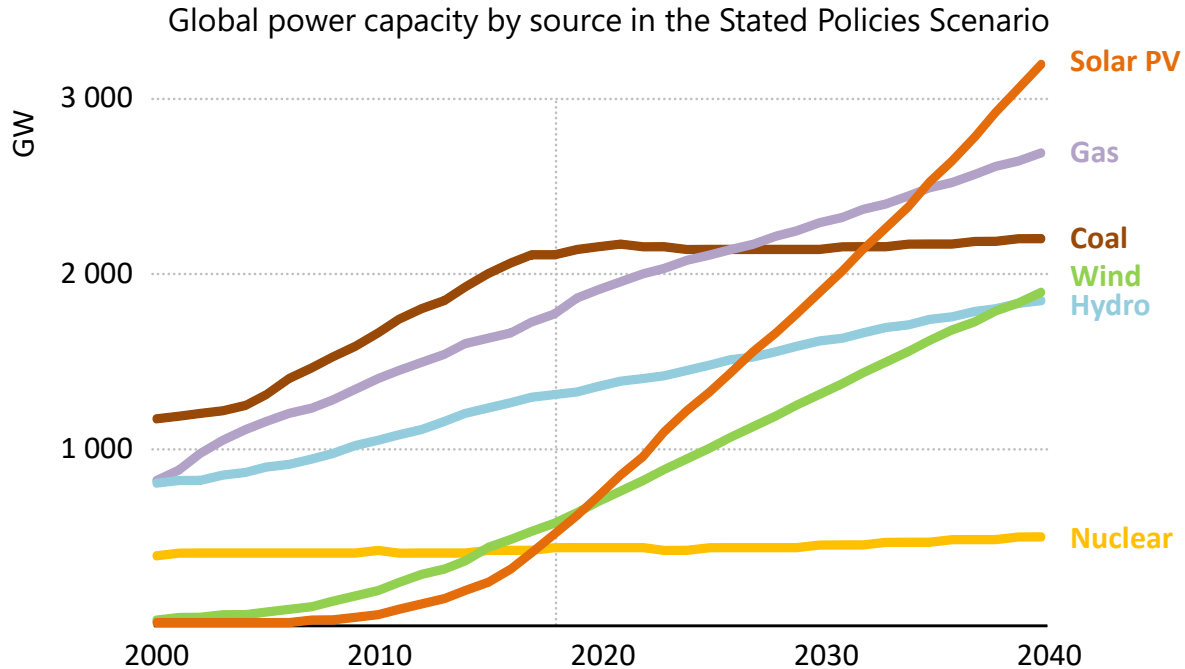
Global energy efficiency improvements are slowing down



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In 2018 the global economy produced 1.2% more value for every unit of energy used compared to 2017. Cost-effective opportunities exist to deliver an annual improvement rate of 3%.

Solar is the star

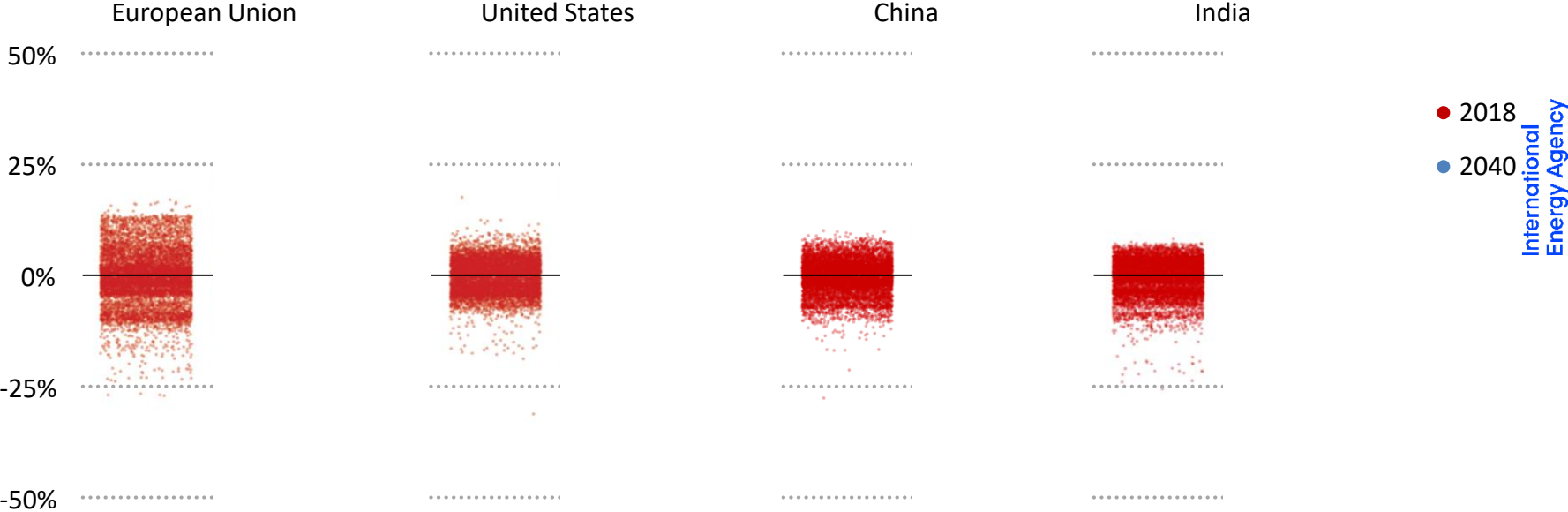


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Renewables provide three-quarters of the growth in electricity supply to 2040 under stated policies but much more is needed: in Sustainable Development Scenario wind and solar capacity in 2040 is 50% higher

Electricity moves to the heart of modern energy security

Hour-to-hour adjustments required in power systems due to variability in demand, wind and solar



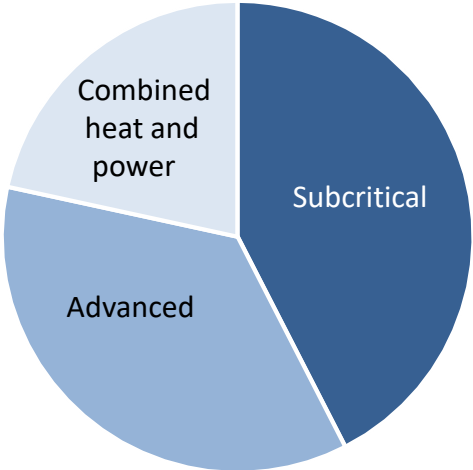
Global needs for flexibility double to 2040, but today's market designs may not bring sufficient investment to deliver it, e.g. in power plants, networks, demand-side response and energy storage in all forms, incl. hydrogen

An unprecedented momentum for hydrogen

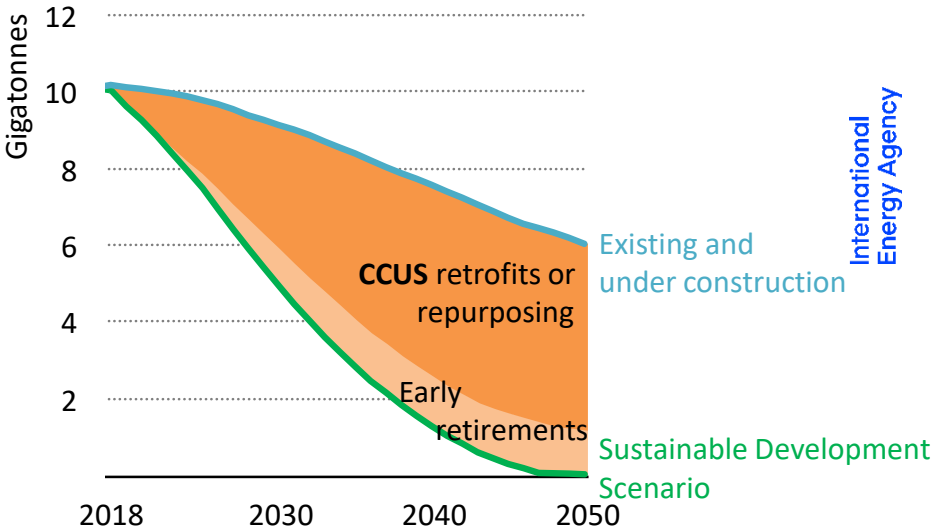
- Hydrogen can help overcome many difficult energy challenges
 - **Integrate more renewables**, including by enhancing storage options & tapping their full potential
 - **Decarbonise hard-to-abate sectors** – steel, chemicals, trucks, ships & planes
 - **Enhance energy security** by diversifying the fuel mix & providing flexibility to balance grids
- But there are challenges: *costs* need to fall; *infrastructure* needs to be developed; *cleaner hydrogen* is needed; and *regulatory barriers* persist
- Hydrogen is produced from fossil fuels, but declining costs of PV & wind increasingly make them a low-cost source for hydrogen including in Latin America, Africa, Middle East, India & Australia

Today's coal plants leave a legacy that technology can address

Coal-fired capacity, existing and under construction:
2 250 GW



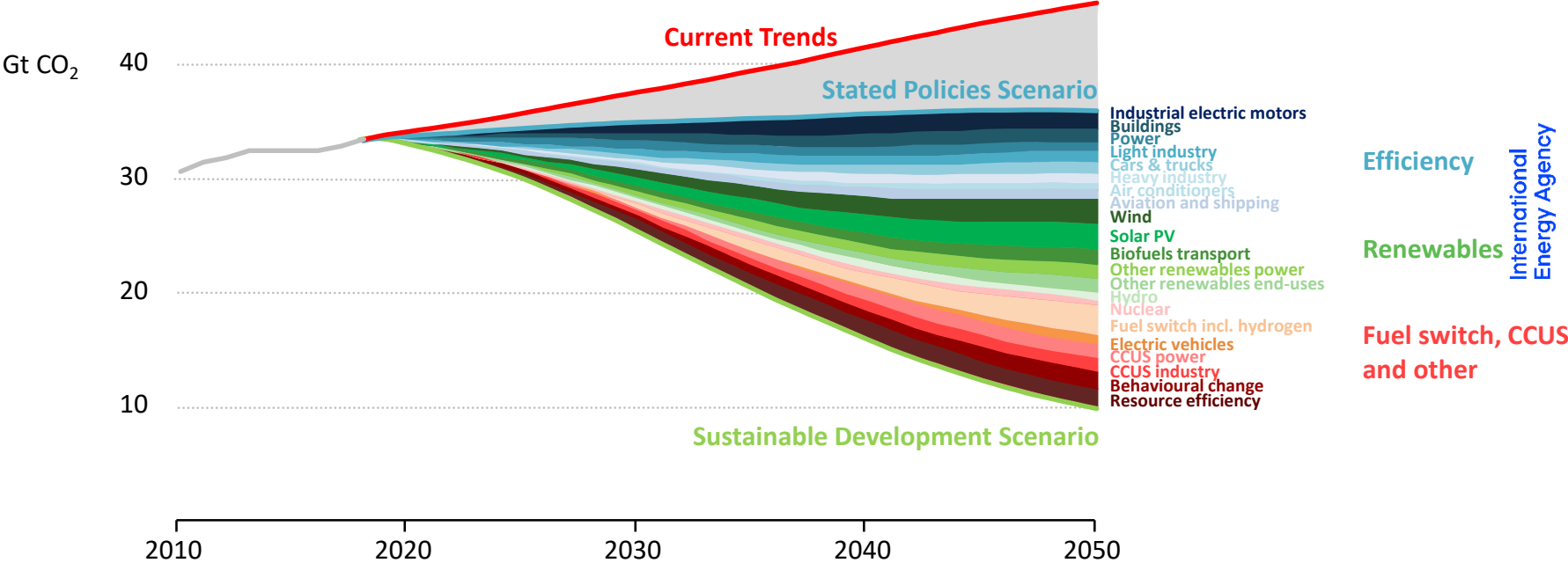
Annual CO₂ emissions from coal-fired power plants



Investment in CCUS will be critical to ensure that the young coal fleet is compatible with climate targets, while repurposing them to provide flexibility can reduce CO₂ and pollutant emissions, and help integrate renewables

No single or simple solutions to reach sustainable energy goals

Energy-related CO₂ emissions and reductions in the Sustainable Development Scenario by source



A host of policies and technologies will be needed across every sector to keep climate targets within reach, and further technology innovation will be essential to aid the pursuit of a 1.5°C stabilisation

Conclusions

- The energy sector is adjusting to new pressures, but the overall response remains far from adequate in view of the energy security & environmental threats the world faces
- While solar, wind, storage & digital technologies are transforming the electricity sector, legacy issues surrounding existing infrastructure also need to be tackled
- Investment in energy efficiency, renewables and more flexible energy systems must significantly accelerate
- The oil & gas industry is critical for some key capital-intensive technologies to reach maturity, including CCUS, low-carbon hydrogen, biofuels, and offshore wind
- The IEA is convening, leading & supporting a [Grand Coalition](#) – made up of govts, industry & civil society – to accelerate global energy transitions that underpin energy security & economic growth

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